AMENDMENTS TO THE CLAIMS:

This listing of claims will replace all prior versions, and listings, of claims in the application:

LISTING OF CLAIMS:

1-14. (canceled)

15) (original) Sensor (Sen) for evaluation of the concentration of analyte elements (a_i) of an analyte (A) which are present in a fluid sample (F) initially included in a sample volume (Vec), this sensor being of the type constituted by:

a) a reaction chamber (Cre) which provides internally a test volume (Vep)

i) in the interior of which a fraction of the fluid sample (F) is channelled,

ii) circumscribed by an enclosing reaction surface (Sev) constituted by:

- a permeable upstream front face (sfam),
- a permeable downstream front face (sfav) opposite permeable upstream front face (sfam),
- and a substantially cylindrical impermeable lateral face (slat) connected by its two ends to the peripheries of the said two upstream (sfam) and downstream (sfav) faces;

b) at least one active component (chemical and/or biological) known as a receptor (R) which is placed in contact with the fluid sample (F) within the test volume (Vep),

i) of which the receptor elements (r_j) have an affinity with the analyte elements (a_i) in order to detect them,

ii) and also having the property [alone or in combination with another active component known as a indicator (U) likewise introduced into the interior of the test volume (Vep)] of modifying a measurable extensive state variable (physical and/or chemical) (E) by an elementary signal (dE) at each occurrence [or according to a certain law of probability] at the time of an event of recognition of an analyte element (a_i) by a receptor element (r_j),

c) a transducer system (T) for measurement of the extensive state variable (E) in order to quantify the presence of the analyte elements (a_i) in the fluid sample (F);

this sensor (Sen) being characterised in that in combination:

d) on the one hand, its reaction chamber (Cre) is a multi-microtubular array (18) constituted by the joining of a plurality of cylindrical microtubular channels (c_1, c_2, ..., c_k, ..., c_n) of substantially equal lengths (l) which are disposed substantially parallel and multi-tangent in such a way as to delimit a dense plurality of adjacent separate convex elementary volumes (vec_1, vec_2, ..., vec_k,..., vec_n) which are open their two ends (ee_k, es_k) and of which the joining forms the non-convex global test volume (Vep), the said non-convex global test volume (Vep) being circumscribed by the enclosing reaction surface (Sev) of which the permeable upstream (sfam) and downstream (sfav) front faces are situated at right angles to the inlet (se_k) and outlet (ss_k) sections of the micro-tubular channels (c_k) ;

e) on the other hand, its transducer system (T) for lateral integral measurement of the extensive state variable (E),

i) is situated entirely
- outside the enclosing surface (Sev) of the reaction chamber (Cre),
- and strictly facing the impermeable lateral face (slat),

ii) and delivers an integral measurement $\Delta E = \Sigma_{k=1...n} \Sigma_{ij} (dE)_{ijk}$, (that is to say a summation) of the variations of the said extensive state variable (E) simultaneously for all the elementary volumes (vec_k) at once, and for all the elementary signals $(dE)_{ijk}$ in each microtubular (c_k) at once through the impermeable lateral face (slat),
in such a way as to quantify globally the presence of the analyte elements (a_i) in the fluid sample (F) in all the microtubular channels (c_k) at once.

16.(original) Immunomagnetic sensor (Sen) according to Claim 15 of the type in which:

a) a fraction at least of the receptor elements (r_j) is combined with indicator elements (u_j) of another active component known as a indicator (U) in such a way as to modify a measurable extensive state variable (physical and/or chemical) (E) by an elementary signal (dE) at each occurrence [or according to a certain law of probability], at the time of an event of recognition of an analyte element (a_i) by a receptor element (r_j),

b) a transducer system (T) for measurement of the extensive state variable (E) in order to quantify the presence of the analyte elements (a_i) in the fluid sample (F), comprising

i) an emitter (11) of a magnetic field (H),

ii) and a receiver (13) of a magnetic field (H) connected to a secondary current analysis device (12),

this sensor (Sen) being characterised in that in combination:

c) on the one hand, the indicator elements (u_j) are constituted by super-paramagnetic particles [and in particular super-paramagnetic micro-granules (sp_j)],

d) on the other hand, the said emitter (11) and receiver (13) of a magnetic field (H) are situated

i) entirely outside the enclosing surface (Sev) of the reaction chamber (Cre) in the form of a multi-microtubular array,

ii) and strictly facing the impermeable lateral face (slat).

17) (original) Immunomagnetic sensor (Sen) according to Claim 16, characterised in that

a) its magnetic field emitter (11) is formed by a primary winding (71) of coils (74) connected to a primary current source (72),

b) its magnetic field receiver (13) is formed by a secondary winding (73) of coils (74) connected to a secondary current analysis device (12),

c) the primary (71) and secondary (73) windings of coils (74) surround the impermeable lateral face (slat) of the reaction chamber (Cre) in the form of a multi-microtubular array.

18) (original) Sensor (Sen) according to Claim 15, characterised in that its reaction chamber (Cre) in the form of a cylindrical monolithic multi-microtubular array (18) is covered with a protective casing (19) in such a way as to form a mobile test cartridge (Car).

19) (original) Sensor (Sen) according to Claim 18, characterised in that the protective casing (19) of its reaction chamber (Cre) is cylindrical.

20) (original) Sensor (Sen) according to Claim 18, characterised in that the protective casing (19) of its reaction chamber (Cre) is conical.

21) (original) Sensor (Sen) according to Claim 18, characterised in that the protective casing (19) of its reaction chamber (Cre) is moulded on over the reaction chamber (Cre).

22) (original) Sensor (Sen) according to Claim 18, characterised in that the protective casing (19) of its reaction chamber (Cre) provides internally a reservoir (21) downstream of the reaction chamber (Cre).

23) (original) Sensor (Sen) according to Claim 18, characterised in that the protective casing (19) of its reaction chamber (Cre) is equipped with a lateral sealing element.

24) (original) Sensor (Sen) according to Claim 23, characterised in that the protective casing (19) of its reaction chamber (Cre) is equipped with a lateral sealing element formed by an annular sealing tongue (20) moulded on at right angles to the upstream end face (22) or the downstream end face (26) of the test cartridge (Car).

25) (original) Sensor (Sen) according to Claim 18, characterised in that the protective casing (19) of its reaction chamber (Cre) is provided with an air hole (25) produced on the downstream end face (26) of the cartridge (Cre).

26) (original) Sensor (Sen) according to Claim 15, characterised in that a sampling needle (39) is adapted in a sealed and removable manner on the protective casing (19) of the reaction chamber (Cre) facing the upstream face (22) of the cartridge (Cre) situated on the side of the permeable upstream front face (sfam) of the reaction chamber (Cre).

27) (original) Sensor (Sen) according to Claim 18, characterised in that the protective casing (19) of the reaction chamber (Cre) is extended:

a) upstream of the upstream end face (22), situated on the side of the permeable upstream front face (sfam) of the multi-microtubular reaction chamber (Cre),

b) in the form of a sampling cone (80) provided with a sampling recess (81) in its end (82).

28) (original) Sensor (Sen) according to Claim 18, characterised in that the protective casing (19) of its multi-microtubular reaction chamber (Cre) is covered laterally with an identification label (83).

29) (original) Sensor (Sen) according to Claim 15 for evaluation of the concentration of a group of analytes (A_1, A_2, A_3, ..., A_p, ...) which are present in a fluid sample (F) initially included in a sample volume (Vec), this sensor being of the type formed by:

a) a multi-stage reactor tube (90), in the interior of which a fraction of the fluid sample (F) is channelled,

b) a plurality of reaction chambers (Cre_1, Cre_2, Cre_3, ..., Cre_p, ...) of substantially equal cross-sections ($SCre_p$), disposed coaxially in a chain and sealed laterally within the reactor tube (90),

c) at least a plurality of active components known as receptors (R_1, R_2, R_3, ..., R_p, ...) which are placed in contact with the fluid sample (F) within the test volumes (Vep_p),

i) of which the receptor elements (r_{pj}) have an affinity with the analyte elements (a_{pi}) of at least one analyte (A_p) in order to detect them,

ii) and also having the property [alone or in combination with another active component known as an indicator (U) likewise introduced into the interior of the test volume (Vep)] of modifying a measurable extensive state variable (physical and/or chemical) (E) by an elementary signal (dE) at each occurrence [or according to a certain law of probability] at the time of an event of recognition of an analyte element (a_{pi}) by a receptor element (r_{pj}),

d) a plurality of transducer systems (T_1, T_2, T_3, ..., T_p, ...) for lateral integral measurement of the extensive state variable (E), each comprising

i) at least one physical measurement receiver (Rmp_1, Rmp_2, Rmp_3, ..., Rmp_p, ...) [such as in particular a magnetic field receiver (13)],

ii) each physical measurement receiver (Rmp_p) fitting over the multi-stage reactor tube (90) at right angles to a corresponding reaction chamber (Cre_p),

e) a system for supplying a plurality of receptor reagents (R_1, R_2, R_3, ..., R_p, ...) specific to the analytes (A_1, A_2, A_3, ..., A_p, ...) ;

this multi-analyte sensor (Sen) being characterised in that in combination:

f) on the one hand, at least two of the reaction chambers (Cre_p) are formed by a multi-microtubular array (18) formed by the joining of a plurality of cylindrical microtubular channels (c_{p1}, c_{p2}, ..., c_{pk}, ..., c_{pn}),

g) on the other hand, at least two transducer systems (T_1, T_2, T_3, ..., T_p, ...) for lateral integral measurement of the extensive state variable (E),

i) are situated entirely

- outside the enclosing reaction surface (Sev_p) of the corresponding reaction chamber (Cre_p),
- and strictly facing the corresponding impermeable lateral face ($slat_p$),

ii) and carry out an integral measurement $\Delta E_p = \Sigma_{k=1...n} \Sigma_{ij} (dE)_{ijpk}$, (that is to say a summation) of the variations of the said extensive state variable (E) simultaneously for all the elementary volumes (vec_{pk}) at once, and for all the elementary signals $(dE)_{ijpk}$ in each elementary channel (c_{pk}) at once through the corresponding impermeable lateral face ($slat_p$) of the reaction chamber (Cre_p).

30) (original) Sensor (Sen) according to Claim 15, further provided with a mobile device (100) for sampling by mobile test cartridge (Car) of analyte elements (a_i) of an analyte (A) [that is to say soluble chemical entities or live or dead micro-organisms, or parts of micro-organisms] which are present in a fluid sample (F), comprising the combination between:

a) a sampling block (102) having an internal sampling cavity (103) of a revolutionary shape (cylinder or truncated cone),

b) a mobile cartridge (Car)

i) of a revolutionary shape (cylinder or truncated cone) complementary to that of the internal sampling cavity (103),

ii) including internally a r eaction chamber (Cre) in the form of a monolithic multi-microtubular array (18),

iii) introduced in a mobile manner into the internal sampling cavity (103) of the sampling block (102),

iv) and sealed laterally relative to the wall (104) of the internal sampling cavity (103),

c) a means for retaining (105) the mobile cartridge (Car) in the sampling block (102),

d) a means for sealing (106) the sampling block (102) after introduction of the mobile cartridge (Car) into the interior,

i) the said sealing means (106) being possibly merged with the said retaining means (105),

ii) providing after activation at least two openings (111, 112) in the sampling block (102):

- an upstream opening (111) for taking the fluid sample (F),
- and a downstream opening (112)

e) a pump (115) for movement of the reagents and fluid sample (F), connected to one or the other of the upstream (111) or downstream (112) sampling openings.

31) (previously presented) Sensor (Sen) according to Claim 30, characterised in that it further comprises at least one reservoir (122) for chemical and/or biological reagent (and in particular for receptor (R)) connected to one or the other of the:

a) upstream sampling opening (111),

b) and/or downstream sampling opening (112),

of the sampling block (102),

c) and of which the pump (115) for movement of the fluids is situated between the opening (111 or 112) and the reservoir (122) for reagents.

32) (original) Sensor (Sen) according to Claim 15, further provided with an independent device for indication after sampling (131) by mobile test cartridge (Car) of analyte elements (a_i) of an analyte (A) which are present in a fluid sample (F), comprising the combination between :

a) an indication block having an internal indication cavity of revolutionary shape (cylinder or truncated cone),

b) a mobile cartridge (Car)

i) of a revolutionary shape (cylinder or truncated cone) complementary to that of the internal indication cavity,

ii) including internally a reaction chamber (Cre) in the form of a multi-microtubular array,

iii) introduced in a mobile manner into the internal indication cavity of the indication block,

iv) and sealed laterally relative to the wall of the internal indication cavity,

c) a means for retaining the mobile cartridge (Car) in the indication block,

d) a means for sealing the indication block after introduction of the mobile cartridge (Car) into the interior of the internal indication cavity,

i) the said sealing means possibly being merged with the said retaining means,

ii) providing after activation at least two openings in the indication block:

- an upstream opening for introduction of reagents,
- and a downstream opening,

e) a pump for movement of the reagents and fluid sample, connected to one or the other of the upstream opening for introduction of reagent or the downstream opening.

33) (original) Sensor (Sen) according to Claim 15, further provided with an independent device for measurement after sampling (151) by mobile test cartridge (Car) of analyte elements (a_i) of an analyte (A) which are present in a fluid sample (F), comprising the combination between :

a) a transduction block (Cme) providing an internal measurement cavity (Eme) of a revolutionary shape (cylinder or truncated cone),

b) a mobile cartridge (Car)

i) of revolutionary shape (cylinder or truncated cone) complementary to that of the internal measurement cavity (Eme),

ii) including internally a reaction chamber (Cre) in the form of a multi-microtubular array (18),

iii) introduced in a mobile manner into the internal measurement cavity (Eme) of the transduction block (Cme),

iv) and sealed laterally relative to the wall (154) of the internal measurement cavity (Eme),

c) a means for retaining (155) the mobile cartridge (Car) in the transduction block (Cme),

d) a transducer system (T) for lateral integral measurement of the extensive state variable (E), comprising at least one physical measurement receiver [such as in particular a magnetic field receiver (13)], connected to the transduction block (Cme) and situated entirely

i) outside the internal measurement cavity (Eme),

ii) and strictly facing the internal measurement cavity (Eme).

34) (previously presented) Sensor (Sen) according to Claim 33, further comprising in combination:

a) a means for sealing (156) the block after introduction of the mobile cartridge (Car) into the interior,

i) the said sealing means (156) being possibly merged with the said retaining means (155),

ii) providing after activation at least two openings in the sampling block:

- an upstream feeding opening (161),
- and a downstream opening (162),

b) a pump (165) for movement of the sample fluids and/or reagents, connected to one or the other of the upstream (161) or downstream (162) sampling openings.

35) (original) Sensor (Sen) according to Claim 15, further provided with a sequential robot device (171) for analysis by mobile test cartridges (Car), formed in combination by:

a) a rigid cartridge support (172) comprising a plurality of blocks (173_a, 173_b, 173_c, 173_d, ...) spaced from one another at a constant pitch (p),

b) a means for periodic displacement of the cartridge support (172) by a spacing (p') equal to the said constant pitch (p) such that the plurality of blocks (173_a, 173_b, 173_c, 173_d, ...) is periodically simultaneously displaced facing an identical plurality of stopping points (181_a, 181_b, 181_c, ...),

c) a plurality of mobile test cartridges (Car_a, Car_b, Car_c, Car_d, ...)

i) including internally a reaction chamber (Cre_a, Cre_b, Cre_c, Cre_d, ...) in the form of a multi-microtubular array (18),

ii) and inserted into the interior of the multitude of blocks (173_a, 173_b, 173_c, 173_d, ...),

d) at least one device for injection of liquid (201_a, 201_b, 201_c, ...) (sample and/or reagent) situated facing a stopping point (181_a, 181_b, 181_c, ...).

36) (previously presented) Sensor (Sen) according to Claim 35, this device (171) being characterised in that furthermore:

a) its rigid cartridge support (172) is formed by a carousel (182),

b) the plurality of blocks (173_a, 173_b, 173_c, 173_d, ...) is positioned on the periphery of the carousel (182) and they are separated by an equal angle at the top (α),

c) the means for periodic displacement ensures the periodic rotation of the carousel (182) at an angle (α).

37) (previously presented) Sensor (Sen) according to Claim 35, this device (171) being characterised in that it further includes a transducer system (T) for lateral integral measurement of the extensive state variable (E), comprising at least one physical measurement receiver (such as in particular a magnetic field receiver (13)),

a) positioned at a stopping point (181_a, 181_b, 181_c, ...),

b) periodically mobile perpendicular to the movement of the cartridge support (172),

c) and periodically coming to mount the test cartridge (Car_d) situated facing it at the stopping point (181_a, 181_b, 181_c, ...), closely surrounding the external surface of the test cartridge (Car_d).

38) (previously presented) Test cartridge (Car_1) for carrying out the method according to **claim 1**, comprising the characteristic combination between:

a) at least one reaction chamber (Cre_1) in the form of a multi-microtubular array (18),

b) and the protective casing (19) covering the said reaction chamber (Cre_1).

39) (original) Multi-chamber test cartridge (Carm) according to Claim 38, characterised in that it further comprises:

a) at least two reaction chambers (Cre_1, ..., Cre_3, ...) in the form of a multi-microtubular array, of identical cross-section, positioned along the axis (zz'),

b) and a protective casing (19) simultaneously covering the reaction chambers (Cre_1, ..., Cre_3,...).

40) (original) Multi-chamber multi-test cartridge (MCarm) according to Claim 38, characterised in that furthermore it is formed by a plurality of test cartridges (Car_1, Car_2, Car_3, ...) disposed end to end in series along one and the same axis (zz').

41) (original) Multi-chamber multi-test cartridge (MCarm) according to Claim 40, characterised in that at least two of its test cartridges (Car_1, Car_2, Car_3, ...) are fitted into one another.